

Application No.: 10/034,030

Docket No.: JCLA8482

AMENDMENTSIn The Claim:

1. (currently amended) A method of fabricating a ceramic substrate with a thermal conductive plug of a multi-chip package, wherein the method comprises:

providing a plurality of green tapes;

forming a plurality of conductive openings and thermal conductive openings passing through ~~on~~ the green tapes;

after forming the conductive openings and the thermal conductive openings, filling a metal paste into the conductive openings and the thermal conductive openings;

after filling the metal paste into the conductive openings and the thermal conductive openings, stacking the green tapes together, wherein the metal paste inside the conductive openings of every green tape is in contact with its neighboring metal paste within the conductive openings of the green tapes, the metal paste inside the thermal conductive openings of each green tape is in contact with its ~~each~~ neighboring metal paste inside the thermal conductive openings;

after stacking the green tapes together, cofiring ~~cofiring~~ those green tapes and the metal paste to form a pre-substrate, wherein the pre-substrate comprises an insulating structure, a plurality of thermal conductive plugs and conductive plugs, the insulating structure is formed by cofiring the green tapes so that a plurality of conductive plugs are formed by ~~due to the~~ cofiring ~~on~~ the metal paste in the conductive openings and a plurality of thermal conductive plugs are ~~also~~ formed by cofiring the metal paste inside the thermal conductive openings, the pre-substrate further comprises a top surface and a bottom surface;

forming a first metal film on the top surface of the pre-substrate;

forming a second metal film on the bottom surface of the pre-substrate;

patterning the first metal film to form a plurality of die pads and conductive traces, the die pads in contacted with the thermal conductive plugs and the conductive traces in contacted with the conductive plugs;

adhering a plurality of chips on the die pads; and

electrically connecting the chips to the conductive traces.

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2. (currently amended) The method of claim 1, wherein a machine punching method is utilized to form the conductive openings and the thermal conductive openings passing through ~~on~~ the green tapes.

3. (original) The method of claim 1, wherein a stencil printing method is utilized to fill the metal paste into the conductive openings and the thermal conductive openings.

4. (original) The method of claim 1, wherein a method of forming the first metal film comprises a sputtering deposition or an evaporation method.

5. (original) The method of claim 1, wherein a method of forming the second metal film comprises a sputtering deposition or an evaporation method.

6. (original) The method of claim 1, wherein the method further comprises a planarizing process after cofiring the green tapes and the metal paste.

7. (original) The method of claim 6, wherein the planarizing process is carried out to planarize the top surface of the pre-substrate by a polishing method.

8. (original) The method of claim 6, wherein the planarizing process is carried out to planarize the bottom surface of the pre-substrate by a polishing method.

9. (currently amended) The method of claim 6, wherein a flat insulating layer is formed on the top surface of the pre-substrate during the planarizing process, and a plurality of openings are formed through ~~on~~ the insulating layer to expose ~~exposure~~ the conductive plugs and the thermal conductive plugs.

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10. (currently amended) The method of claim 6, wherein a flat insulating layer is formed on the bottom surface of the pre-substrate during the planarizing process, and a plurality of openings are formed through ~~on~~ the insulating layer to expose ~~exposure~~ the conductive plugs and the thermal conductive plugs.

11. (currently amended) The method of claim 1, wherein a maximum width of the thermal conductive openings is approximately between 20 milli-inches and ~~to~~ 40 milli-inches.

12. (currently amended) The method of claim 1, wherein photolithographic and etching techniques are ~~a photographic etching method is~~ used to pattern the first metal film.

A 13. (currently amended) The method of claim 1, wherein the pre-substrate further comprises a plurality of aligning-mark holes, which are formed like ~~into~~ cavity-shaped holes and are used to align a mask layer to the pre-substrate.

14. (currently amended) The method of claim 13, wherein a fabricating method of the aligning-mark holes, comprising

forming a plurality of aligning holes passing through ~~on a predetermined number at least one of the~~ green tapes while forming the conductive openings and the thermal conductive openings passing through ~~on~~ the green tapes;

stacking together with aligning the green tapes with ~~according to~~ the aligning holes, going with the aligning holes aligned with each other, on the predetermined number of green tapes and stacking together with the green tapes without the aligning holes while stacking the green tapes together; and

forming the ~~plurality of~~ aligning-mark holes from the aligning holes after cofiring the green tapes and the metal paste.

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15. (withdrawn) A method of fabricating a ceramic substrate with a thermal conductive plug, comprising:

providing a plurality of green tapes;

forming at least a conductive opening and at least a thermal conductive opening on every green tape;

filling a metal paste into the conductive openings and the thermal conductive openings;

stacking the green tapes together, wherein the metal paste inside the conductive openings of every green tape is in contact with its neighboring metal paste within the conductive openings of the green tapes, the metal paste inside the thermal conductive openings of each green tape is in contact with each neighboring metal paste inside the thermal conductive openings;

cofiring those green tapes and the metal paste to form a pre-substrate, wherein the pre-substrate comprises an insulating structure, at least a thermal conductive plug and at least a conductive plug, the insulating structure is formed by cofiring the green tapes so that the conductive plug is formed by cofiring the metal paste in the conductive opening and the thermal conductive plug is formed by cofiring the metal paste inside the thermal conductive opening;

forming a metal film on the pre-substrate; and

patterning the first metal film to form at least a die pad and at least a conductive trace, the die pad in contacted with the thermal conductive plug and the conductive trace in contacted with the conductive plug.

16. (withdrawn) The method of claim 15, wherein a machine punching method is utilized to form the conductive opening and the thermal conductive opening on every green tape.

17. (withdrawn) The method of claim 15, wherein a stencil printing method is utilized to fill the metal paste into the conductive opening and the thermal conductive opening.

18. (withdrawn) The method of claim 15, wherein a method of forming the metal film on the pre-substrate comprises a sputtering deposition or an evaporation method.

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19. (withdrawn) The method of claim 1, wherein the method further comprises a planarizing process after cofiring the green tapes and the metal paste.

20. (withdrawn) The method of claim 19, wherein the planarizing process is carried out to planarize the pre-substrate by a polishing method.

21. (withdrawn) The method of claim 19, wherein a flat insulating layer is formed on the pre-substrate during the planarizing process, and a plurality of openings are formed on the insulating layer to expose the conductive plug and the thermal conductive plug.

22. (withdrawn) The method of claim 15, wherein a maximum width of the thermal conductive opening is approximately between 20 milli-inches to 40 milli-inches.

23. (withdrawn) The method of claim 15, wherein a photographic etching method is used to pattern the first metal film.

24. (withdrawn) The method of claim 15, wherein pre-substrate further comprises at least an aligning-mark holes, which is formed into a cavity-shaped hole and is used to align a mask layer to the pre-substrate.

25. (withdrawn) The method of claim 24, wherein a fabricating method of the aligning-mark hole, comprising

forming at least an aligning hole on at least a green tape while forming the conductive opening and the thermal conductive opening on the green tapes;

aligning the green tapes according to the aligning hole on the green tape and stacking together with at least another green tape without the aligning hole; and

forming the aligning-mark hole from the aligning holes after cofiring the green tapes and the metal paste.

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26. (currently amended) A method of fabricating a ceramic substrate with a thermal conductive plug, comprising:

providing a plurality of green tapes;

forming a plurality of at least a thermal conductive openings passing through the ~~on~~ green tapes;

after forming the thermal conductive openings, filling a metal paste into the thermal conductive openings;

after filling a metal paste into the thermal conductive openings, stacking the green tapes together, wherein the metal paste inside the thermal conductive openings of the green tapes is in contact with ~~its each~~ neighboring metal paste inside the thermal conductive openings;

after stacking the green tapes together, ~~cofiring~~ ~~cofiring~~ those green tapes and the metal paste to form a pre-substrate, wherein the pre-substrate comprises an insulating structure, at least a thermal conductive plug, the insulating structure is formed by cofiring the green tapes and so ~~that~~ the thermal conductive plug is formed by cofiring the metal paste inside the thermal conductive openings;

forming a metal film on the pre-substrate; and

patterning the first metal film to form at least a die pad, and the die pad is in contact with the thermal conductive plug.

27. (currently amended) The method of claim 26, wherein a machine punching method is utilized to form the thermal conductive openings passing through ~~on every~~ green tapes.

28. (currently amended) The method of claim 26, wherein a stencil printing method is utilized to fill the metal paste into the thermal conductive openings.

29. (original) The method of claim 26, wherein a method of forming the metal film on the pre-substrate comprises a sputtering deposition or an evaporation method.

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30. (original) The method of claim 26, wherein the method further comprises a planarizing process after cofiring the green tapes and the metal paste.

31. (original) The method of claim 30, wherein the planarizing process is carried out to planarize the pre-substrate by a polishing method.

32. (currently amended) The method of claim 30, wherein a flat insulating layer is formed on the pre-substrate during the planarizing process, and at least an opening is formed through ~~on~~ the insulating layer to expose ~~exposure~~ the thermal conductive plug.

33. (currently amended) The method of claim 26, wherein a maximum width of the thermal conductive opening is approximately between 20 milli-inches and ~~to~~ 40 milli-inches.

34. (currently amended) The method of claim 26, wherein photolithographic and etching techniques are a ~~photographic etching method is~~ used to pattern the first metal film.

35. (currently amended) The method of claim 26, wherein pre-substrate further comprises a plurality of at least an aligning-mark holes, which are ~~is~~ formed like ~~into~~ a cavity-shaped holes and are ~~is~~ used to align a mask layer to the pre-substrate.

36. (currently amended) The method of claim 35, wherein a fabricating method of the aligning-mark hole, comprising

forming a plurality of at least an aligning holes passing through ~~on~~ at least one of the a green tapes while forming the thermal conductive openings passing through the ~~on every~~ green tapes;

stacking together with ~~aligning and stacking~~ the green tapes with ~~according to~~ the aligning holes, going with the aligning holes aligned with each other, on the green tape and ~~stacking together with the at least another green tapes without the aligning holes while stacking the green tapes together;~~ and

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forming the aligning-mark holes ~~from the aligning holes~~ after cofiring the green tapes and the metal paste.

37. (currently amended) A method of fabricating a ceramic substrate with a thermal conductive plug, comprising:

providing a plurality of green tapes;

forming a plurality of at least a thermal conductive openings passing through the ~~on~~ green tapes, wherein a maximum width of the thermal conductive openings is approximately between 20 milli-inches and ~~to~~ 40 milli-inches;

after forming the thermal conductive openings, filling a metal paste into the thermal conductive openings;

after filling the metal paste into the thermal conductive openings, stacking the green tapes together, wherein the metal paste inside the thermal conductive openings of the green tapes is in contact with its ~~each~~ neighboring metal paste inside the thermal conductive openings; and

cofiring ~~cofiring~~ those green tapes and the metal paste.

38. (currently amended) The method of claim 37, wherein a machine punching method is utilized to form the thermal conductive openings passing through the ~~on every~~ green tapes.

39. (currently amended) The method of claim 37, wherein a stencil printing method is utilized to fill the metal paste into the thermal conductive openings.

40. (currently amended) A method of fabricating a ceramic substrate with a thermal conductive plug, comprising:

providing a plurality of green tapes;

forming a plurality of at least a thermal conductive openings passing through the ~~on~~ green tapes;

after forming the thermal conductive openings, filling a metal paste into the thermal conductive openings;



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after filling the metal paste into the thermal conductive openings, stacking the green tapes together, wherein the metal paste inside the thermal conductive openings of the green tapes is in contact with its each neighboring metal paste inside the thermal conductive openings; and

after stacking the green tapes together, cofiring ~~cofiring~~ those green tapes and the metal paste to form a pre-substrate, wherein the pre-substrate comprises an insulating structure, at least a thermal conductive plug, the insulating structure is formed by cofiring the green tapes and so ~~that~~ the thermal conductive plug is formed by cofiring the metal paste inside the thermal conductive opening.

41. (currently amended) The method of claim 40, wherein a machine punching method is utilized to form the thermal conductive openings passing through the ~~on every~~ green tapes.

42. (currently amended) The method of claim 40, wherein a stencil printing method is utilized to fill the metal paste into the thermal conductive openings.

43. (currently amended) The method of claim 40, wherein a maximum width of the thermal conductive opening is approximately between 20 milli-inches and ~~to~~ 40 milli-inches.

44. (withdrawn) A method of fabricating a ceramic substrate with an aligning-mark hole, comprising:

providing a plurality of green tapes;

forming at least an aligning hole on at least one of the green tapes,

aligning and stacking the green tapes according to the aligning hole on the green tape and stacking together with at least another green tape without the aligning hole; and

cofiring the green tapes to form a pre-substrate, wherein the pre-substrate comprises at least a pair of aligning-mark holes, and the aligning-mark holes are induced from at least a pair of aligning holes so that the aligning-mark holes are formed into a cavity-shaped.

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45. (withdrawn) The method of claim 44, wherein a machine punching method is utilized to form the aligning-mark holes on the green tape.

46. (withdrawn) The method of claim 44, wherein a maximum diameter of the aligning-mark holes is approximately between 10 milli-inches to 25 milli-inches.

47. (withdrawn) A method of fabricating a ceramic substrate with an aligning-mark hole, comprising:

a<sup>1</sup> providing a plurality of green tapes;

forming a plurality of aligning holes on a predetermined number of the green tapes,

aligning and stacking the green tapes according to the aligning holes on the green tapes and stacking together with at least another green tape without the aligning hole; and

cofiring the green tapes to form a pre-substrate, wherein the pre-substrate comprises a plurality of aligning-mark holes, and the aligning-mark holes are induced from a plurality of aligning holes so that the aligning-mark holes are not drilled through and formed into a cavity-shaped.

48. (withdrawn) The method of claim 47, wherein a machine punching method is utilized to form the aligning-mark holes on the green tape.

49. (withdrawn) The method of claim 47, wherein a maximum diameter of the aligning-mark holes is approximately between 10 milli-inches to 25 milli-inches.